10 GHz Signal Source

User Manual

10 GHz Signal Source User Manual

Acknowledgements

This Signal Source is based on the design described by Jeff Wadsworth, KI5WL in an article published in the May/June 2015 edition of QEX (a bimonthly magazine published by the American Radio Relay League).

10 GHz Signal Source User Manual

Table of Contents

10 GHz Signal Source User Manual

Scope of Document

This manual provides information on the design and use of the 10 GHz Signal Source. The unit is supplied by UKRAA as a complete unit, apart from the battery.

10GHz Signal Source Description

The 10 GHz signal source uses a miniature motion sensor module, the ST Electronics HB100. It generates a signal between 10.368 and 10.370 GHz.

Fig 1 shows the circuit diagram of the 10 GHz signal source.

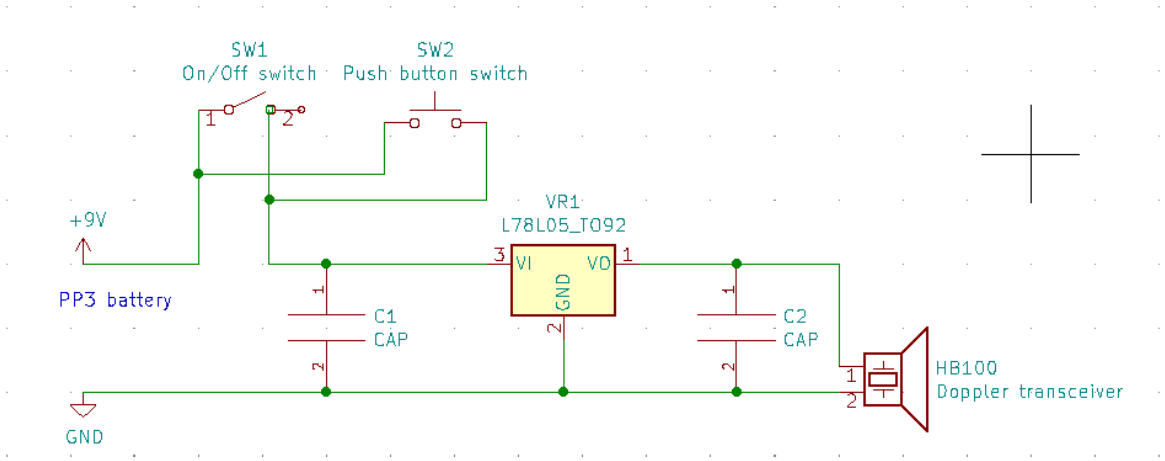


Fig 1: Circuit diagram of 10 GHz Signal Source

The 10 GHz signal source is primarily intended for use with a microwave radio telescope. There are various designs for simple microwave radio telescopes using a 60cm satellite dish and a modified 'SatFinder'. See for example:

- Radio Astronomy Projects by William Lonc Third edition pp 99-105 (Beginners Microwave Telescope);

- The 12 GHz radio astronomy telescope designed by Society of Amateur Radio Astronomy Members Kerry Smith and Chuck Forster and described at http://www.aoc.nrao.edu/epo/teachers/ittybitty/procedure.html (Itty Bitty Telescope).

These can be built for under £100 and are a cheap and simple introduction to radio astronomy.

They receive frequencies in the 10-12 GHz range, can detect the Sun and can detect blackbody radiation from trees, buildings, people etc. With a 1m satellite dish they should be able to detect the Moon.

Power Supply

The motion sensor module is powered by a 9V PP3 battery, which is fed through a 5V voltage regulator.

To fit the PP3 battery, remove the 4 screws holding the lid to the Enclosure, clip the battery into the press stud battery clip, seat the battery on top of the radar module and replace the 4 screws.

Use of the 10 GHz Signal Source

The 10 GHz Signal Source can be used to:

- Test the operation of a Microwave telescope.
- Measure the receive beamwidth of a Microwave satellite dish.
- Cable testing (with modification).
- To test whether or not an amateur radio X-band Receiver can 'hear'.

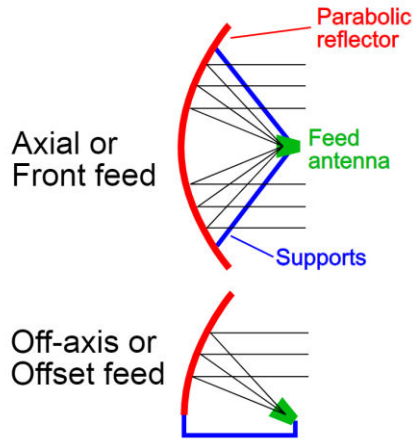
These functions are described in more detail below.

Test the operation of a Microwave telescope

The 10 GHz Signal Source can be used to check that a microwave radio astronomy telescope and its gain control are working properly ie using it as an 'artificial Sun'.

In order to do this, turn on the telescope and adjust the gain control so that the output is at its minimum. Stand in front of the telescope dish, switch on the Signal Source, either using the rocker switch or the push button switch and point it at the centre of the dish.

If the telescope dish has an offset feed (see below), the dish should be tilted downwards.



The telescope output should increase significantly when the Signal Source is switched on. For a typical SatFinder solar telescope, the signal needle should swing from low (0-2) to maximum (10).

Measure the offset of a Microwave satellite dish

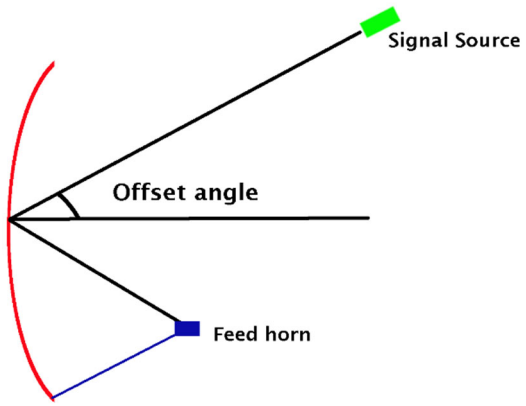
Unless you have an aerial rotator, this procedure is best carried out by two persons: one adjusting the position of the satellite dish and the other reading the telescope output and adjusting the gain control.

When the front face of the satellite dish is vertical, the beam elevation angle up towards the signal being detected is the offset angle.

The advantages of an offset fed dish are, firstly, the beam is not obstructed by either the feed or the feed support, which leads to a cleaner beam pattern and higher efficiency and, secondly, the feed points towards the sky (at least at lower elevation angles), so any "spillover" sees the cold sky rather than the ground, leading to a lower antenna temperature.

To measure the offset of a satellite dish, position the Signal Source so that it is directly in front of the dish (perpendicular to the face of the dish) at a distance of about 5 metres. Turn on the telescope, switch on the Signal Source using the rocker switch and adjust the telescope gain control so that the output is at its minimum. Note the position of the dish – if using a rotator with a dial, note the angle shown on the dial. Rotate the dish up/down until the output increases to its maximum level. Turn the gain down if the signal level is at full deflection (maximum) and repeat the process until the signal level it at is highest.

Measure the angle between the initial position and 'maximum signal' position of the dish. This is the offset angle.



Measure the receive beamwidth of a Microwave satellite dish

As with the previous section, unless you have an aerial rotator, this procedure is best carried out by two persons: one adjusting the position of the satellite dish and the other reading the telescope output and adjusting the gain control.

To measure the receive beamwidth of a satellite dish, position the Signal Source so that it is directly in front of the dish at a distance of about 5 metres and, if using an offset dish, is at the appropriate angle above the dish (see previous section). Turn on the telescope, switch on the Signal Source using the rocker switch and adjust the telescope gain control so that the output is at its minimum. With a typical 'SatFinder' telescope, the signal level should drop sharply at the edge of the receive beamwidth. Note the position of the dish. Rotate the dish to the other side until the output again decreases to its minimum level. Measure the angle between the two positions, which is the receive beamwidth.

Cable testing

The Wadsworth article referenced above describes how the Signal Source can be used with a power meter to measure loss in cables, an attenuator, and to check the SWR of X-band antennas. In order to use the Signal Source for these purposes, it will be necessary to modify it by tapping in a coax cable leading to an SMA connector, as described in the article.

To test whether or not an amateur radio X-band Receiver can 'hear'

The 10 GHz Signal Source can be used to test whether or not an amateur radio X-band Receiver can 'hear', particularly when operating as a mobile rig.

Turn the Receiver on and tune it to a frequency within the transmission band of the Signal Source (between 10.52 GHz and 10.53 GHz). Turn the Signal Source on,

remove the top cover and adjust the set screw at the top of the transceiver module – this will probably be covered by a paper "QC" label, which you will need to remove. Turn the screw slowly until you detect the signal on the Receiver, which will sound like noise. Note the receiver frequency value. When operating as a mobile rig, tune the receiver to the reference frequency, press the push button switch on the Signal Source and check for an increase in the noise level.

HB100 Characteristics

Parameter	Minimum	Typical	Maximum
Frequency/GHz	10.520	10.525	10.530
Radiated Power/dBm	12	15	20
Supply Voltage/V dc	4.74	5.00	5.25
Current/mA		30	40

Contacts

The UK Radio Astronomy Association
Springfield
Rookery Hill
Ashtead
Surrey
KT21 1HY

E-mail: info@ukraa.com

Website: www.ukraa.com

BAA Radio Astronomy Group
Website: www.britastro.org/radio

10 GHz Signal Source User Manual

Charitable Incorporated Organisation

Registered Charity in England and Wales No. 1123866

